

Learning strategies in distance nursing education during the COVID-19 lockdown: a cross-sectional analysis

Khadija Ait Moussa^{1,2}, Sabah Selmaoui¹, Nadia Ouzennou²

¹Interdisciplinary Research Laboratory in Didactics, Education, and Training (LIRDEF-UCA), École Normale Supérieure, Cadi Ayyad University, Marrakech, Morocco

²Higher Institute of Nursing Professions and Health Techniques of Marrakech (ISPITS-M), Ministry of Health and Social Protection, Marrakech, Morocco

Article Info

Article history:

Received Oct 24, 2024

Revised Apr 17, 2025

Accepted May 9, 2025

Keywords:

Blended learning

COVID-19 pandemic

Distance nursing education

Learning strategies

Nursing students

ABSTRACT

The COVID-19 pandemic led to a rapid transition to distance learning (DL), significantly affecting nursing students due to the disruption of essential practical training. This cross-sectional descriptive study examines the learning strategies (LS) adopted by 200 students at the Higher Institute of Nursing and Health Techniques of Marrakech (ISPITS-M) and identifies the factors influencing their adoption. Data were collected using a structured, expert-validated questionnaire (Cronbach's $\alpha=0.72$). Statistical analyses, conducted using SPSS (version 25.0), included descriptive, bivariate, and multivariate analyses. The findings indicate a predominance of metacognitive strategies, such as planning and time management (63.8%), and cognitive strategies, including memorization (58.9%), which were often adopted intuitively. The blended learning mode (synchronous and asynchronous) ($OR=0.621$; $p=0.013$) and student satisfaction with pedagogical modalities ($OR=1.446$; $p=0.019$) emerged as key determinants of learning strategy adoption. These findings underscore the need to develop structured blended learning environments that foster interaction, student engagement, and digital competency training. Implementing targeted pedagogical interventions could enhance academic performance and adaptability, addressing the specific needs of health sciences education while promoting long-term student success.

This is an open access article under the [CC BY-SA](#) license.



Corresponding Author:

Khadija Ait Moussa

Interdisciplinary Research Laboratory in Didactics, Education, and Training (LIRDEF-UCA)

École Normale Supérieure, Cadi Ayyad University

Hay Hassani Route d'Essaouira, Marrakech 40000, Marrakech, Morocco

Email: aitmoussakhadija33@gmail.com

1. INTRODUCTION

The COVID-19 pandemic profoundly disrupted global education systems, imposing a rapid and often unplanned transition to distance learning (DL). This shift, referred to as emergency remote teaching [1], exposed the limitations of existing pedagogical approaches, highlighting a gap between the requirements for effective learning and technological and organizational constraints [2]–[6]. In the absence of specific training in digital tools and appropriate support mechanisms, students were required to develop greater autonomy, often without sufficient pedagogical or instructional support [7]–[11]. This situation exacerbated educational inequalities, particularly in developing countries, where digital infrastructure remains limited [12]–[15]. In Morocco, the closure of educational institutions led to the widespread adoption of DL, revealing major logistical and pedagogical challenges [16]–[18]. Disparities in access to digital devices and the internet have

further deepened learning inequalities, particularly in the most disadvantaged regions [19]–[21]. Nursing education, like other health sciences disciplines, was particularly affected by the suspension of practical training, which is essential for developing clinical competencies [2], [13], [22], [23]. In this context, students had to adapt their learning strategies (LS) to an exclusively digital environment, alternating between synchronous and asynchronous modalities.

LS play a crucial role in this adaptation, enabling students to manage their learning and compensate for the limitations of DL. Defined as intentional actions that facilitate the acquisition of knowledge and skills, LS encompass cognitive, metacognitive, affective, and organizational dimensions [24]. However, explicit mastery of these strategies remains limited [25]–[27], potentially hindering students' ability to adapt in times of crisis. Moreover, little research has examined the use of LS in developing countries, particularly in educational contexts affected by major health crises [28], [29].

The effectiveness of online learning is directly influenced by synchronous and asynchronous teaching approaches. Real-time interaction characteristic of synchronous modalities foster higher student engagement, while asynchronous methods provide flexibility that supports autonomous learning, though potentially at the expense of student engagement [9], [10], [30]. A combination of both modalities is identified as optimal for enhancing pedagogical effectiveness and improving student satisfaction [11], [21]. Nevertheless, the lack of physical interactions inherent in DL may negatively affect students' sense of community and belonging, crucial aspects in technical and professional training programs [10], [21], [31].

Unlike previous studies, which have predominantly focused on general educational contexts or broadly evaluated the overall effectiveness of DL, the present study introduces a significant novelty by specifically investigating LS adopted by nursing students during the COVID-19 lockdown within the particular context of a developing country, namely Morocco. Furthermore, it adopts an innovative approach by thoroughly examining the personal, technological, and pedagogical determinants influencing the adoption of these strategies, thus providing a comprehensive understanding tailored specifically to the characteristics and requirements of nursing education. Within this perspective, the precise objectives of this research are i) to identify the most frequently adopted LS by nursing students in DL contexts and ii) to rigorously analyze the personal, technological, and pedagogical factors associated with these strategies. The findings will enable the development of concrete, targeted recommendations aimed at optimizing online learning environments, effectively structuring the acquisition of appropriate LS, and strengthening pedagogical support in nursing education programs, as well as more broadly within health sciences training.

2. METHOD

2.1. Study design and target population

This cross-sectional descriptive study was conducted among 200 undergraduate students enrolled in various programs at the Higher Institute of Nursing and Health Techniques of Marrakech (ISPITS-M). Data collection was carried out online using an online questionnaire administered over three months (April to June 2020). Participants were recruited through non-probability sampling (convenience sampling), based on their availability and access to the online platform.

The inclusion criteria were as: being enrolled in an undergraduate program at ISPITS-M, having participated in DL courses during the confinement period (March to June 2020), and voluntarily consenting to participate in the study. The total student population at ISPITS-M for the 2019–2020 academic year was 648 students. The total sample size was calculated using Cochran's formula.

$$n = \frac{t^2 \times p(1 - p)}{m^2}$$

where,

n=required sample size

t=confidence level at 95% (standard value: 1.96)

p=estimated prevalence

m=margin of error at 5% (standard value: 0.05)

The minimum required sample size was 241 participants. However, after excluding incomplete questionnaires, the final sample consisted of 200 students, representing approximately 31% of the target population. Although slightly below the theoretical estimate, this sample size is sufficient for reliable descriptive and inferential analyses.

2.2. Data collection instrument

A structured questionnaire, specifically designed for this study, was utilized. It was distributed via the ISPITS-M official online platform and through social media to maximize participation. The questionnaire primarily comprised closed-ended questions, multiple-choice questions, and Likert-type scales (1=not at all, 5=completely) to assess satisfaction, LS, and participants' perceptions. The average time required to complete the questionnaire was estimated at 10 minutes, based on feedback from the pretest.

The questionnaire comprised three main sections. The first covered demographic and academic data, including gender, age, level of study, program, and place of residence. The second section focused on students' experiences with DL, particularly their previous exposure, course accessibility, overall satisfaction, and adaptation to pedagogical approaches. Finally, the third section explored LS, drawing inspiration from the *Mes Outils de Travail Intellectuel* (My Intellectual Work Tools) framework [32]. This section assessed cognitive strategies (memorization, reformulation, exemplification), metacognitive strategies (planning, self-assessment), and affective strategies (engagement/involvement).

2.3. Validation of the questionnaire

The questionnaire underwent a two-stage validation process. First, a panel of three experts in pedagogy and education assessed content validity, leading to adjustments that simplified ambiguous questions and incorporated examples to clarify specific concepts. Following this, a pretest was conducted with fifteen students who were excluded from the main sample. Their feedback contributed to refining technical definitions and reducing the number of options in the satisfaction scales. The reliability of the instrument was confirmed with a Cronbach's alpha coefficient of 0.72, indicating acceptable internal consistency.

2.4. Data collection and analysis

Data were collected anonymously online, in compliance with ethical standards, and analyzed using SPSS (version 25.0) following a rigorous methodology. Descriptive analysis was conducted to summarize qualitative variables using frequencies and percentages, while quantitative variables were expressed as means and standard deviations. Bivariate analysis examined associations between categorical variables using the Chi-square test (χ^2) and Fisher's exact test. The Chi-square test was applied when expected frequencies in each cell exceeded five. If more than 20% of cells had expected frequencies below five, Fisher's exact test, based on the hypergeometric distribution, was used. Statistical significance was set at $p \leq 0.05$ [33], [34].

For multivariate analysis, variables with significant associations in the bivariate analysis were incorporated into generalized estimating equation (GEE) models to assess the simultaneous impact of multiple explanatory factors on LS [35]. The GEE model was chosen for its ability to account for intra-individual correlations and provide robust estimates in longitudinal or cross-sectional data with structural dependencies [36]. This approach is particularly well-suited for modeling the influence of multiple explanatory factors on the adoption of LS. Beta coefficients (β) were estimated for each explanatory variable, and odds ratios (OR) were computed to assess the relative impact of each factor. Confidence intervals (CI) at 95% (95% CI) were used to evaluate estimate precision, with statistical significance set at $p < 0.05$ [36]. The overall quality of the model was assessed using Nagelkerke's Pseudo- R^2 , which quantifies the proportion of variance explained by the model, while the Wald Chi-square test evaluated the model's global significance [37]. This methodology, complemented by essential diagnostics, facilitated the identification of key determinants of LS while ensuring robust and reliable findings.

3. RESULTS

3.1. Descriptive analysis

3.1.1. Participant characteristics and distance learning practices

The study included 200 students, predominantly female (76%, $n=152$), with a mean age of 20 years (standard deviation=2.39). Most participants lived in urban areas (74.5%, $n=149$), primarily with their parents (85%, $n=170$), and were enrolled in nursing programs (81.5%, $n=163$). Although 33% ($n=66$) reported selecting their field of study by chance, 91% ($n=182$) expressed satisfaction with their choice.

Regarding DL, 79.5% ($n=159$) had no prior experience with this mode of education. Courses were predominantly delivered synchronously (43%, $n=86$), with fixed schedules (77%, $n=154$) and teaching materials provided prior to sessions (79%, $n=158$). Social media platforms were the primary tools used (80%, $n=160$). In terms of technology, 96.5% ($n=193$) had access to appropriate devices, primarily smartphones (90.3%, $n=180$). However, only 59% ($n=118$) had unrestricted internet access. Despite these resources, 69.5% ($n=139$) expressed dissatisfaction with DL, and 56% ($n=112$) rated their technological proficiency as average, highlighting a need for additional training.

3.1.2. Adopted learning strategies

The majority of students (84.5%, n=169) reported having no specific knowledge of LS, indicating an intuitive rather than explicit use of these strategies. The most frequently adopted strategies included work planning and time management (63.8%, n=127), memorization through appropriation (58.9%, n=118), and academic engagement (47.6%, n=95). Additionally, 41.6% (n=83) mentioned using reformulation strategies and identifying relationships between course ideas.

Understanding how students adapt their LS in a DL context is essential for developing targeted pedagogical interventions. Figure 1 provides a visual representation of the distribution of these strategies, emphasizing the predominance of cognitive and metacognitive approaches. It illustrates how students intuitively develop strategies despite the absence of explicit instruction in LS, reinforcing the need for structured training to enhance learning efficiency.

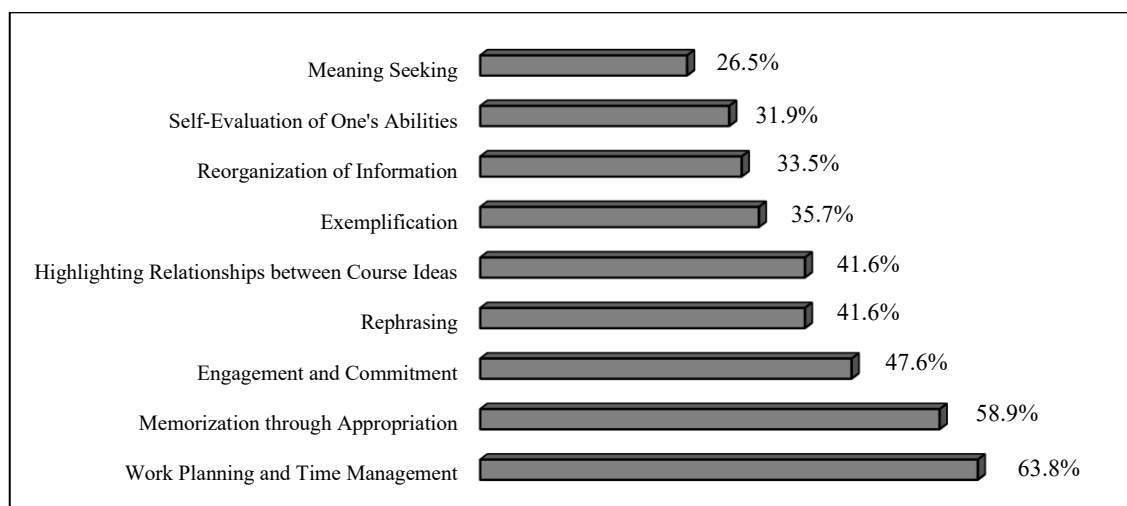


Figure 1. LS during the lockdown

3.2. Bivariate analysis: associations between variables and learning strategies

Descriptive analyses identified trends in DL practices and LS adopted by students. These preliminary findings guided a bivariate analysis to examine significant associations between student characteristics, DL practices, and LS, as shown in Table 1. The key results are as:

- Knowledge of LS: students with prior knowledge of LS were more likely to use strategies such as reformulation ($p=0.047$) and anticipating evaluation or knowledge application situations ($p=0.007$). These results highlight the importance of guided learning with explicit strategies.
- Proficiency in digital tools: strong proficiency in digital tools was positively associated with meaning-making and information-seeking strategies ($p=0.017$) as well as work planning and time management ($p=0.027$), suggesting that technological skills enhance organization and cognitive engagement.
- Internet access: students with unrestricted internet access were more likely to employ strategies such as identifying relationships between course concepts ($p=0.012$) and anticipating evaluations or knowledge application ($p=0.012$). This underscores the critical role of technological accessibility in supporting structured learning.
- DL mode: students following a blended learning model (synchronous and asynchronous) were significantly more likely to adopt exemplification strategies ($p=0.013$), information reorganization ($p=0.029$), and academic engagement ($p=0.045$). These findings highlight the effectiveness of blended online learning in fostering active engagement and deeper learning.
- Satisfaction with DL: students satisfied with DL modalities more frequently employed strategies such as reformulation ($p=0.011$), identifying relationships ($p<0.001$), and self-assessment of abilities ($p=0.043$). These associations suggest that pedagogical satisfaction is a key driver for promoting effective learning practices.

Non-significant variables were excluded from the multivariate analysis to focus on the most relevant factors. These findings provide a solid foundation for further analysis and for identifying key determinants of LS in the DL context.

Table 1. Key associations between explanatory factors and adoption of LS

Explanatory factors	Associated strategies	p-value
Knowledge of LS	Reformulation	0.047*F
	Anticipating evaluation or knowledge application situations	0.007*F
Proficiency with digital tools	Meaning-making and information-seeking	0.017*
	Work planning and time management	0.027*
Unrestricted internet access	Identifying relationships between course ideas	0.012*
	Anticipating evaluation or knowledge application situations	0.012*F
DL mode	Exemplification	0.013*
	Information reorganization	0.029*
	Study engagement	0.045*
Satisfaction with DL	Reformulation	0.011*F
	Identifying relationships between course ideas	<0.001*
	Self-assessment of abilities	0.043*

*Statistical significance at $p < 0.05$; F: Chi-square test (χ^2) was used when expected frequencies were sufficient; Fisher's exact test was applied in other cases.

3.3. Multivariate analysis: key determinants of learning strategies

The multivariate analysis, conducted using GEE models, identified two key determinants influencing the LS adopted by students, as seen in Table 2.

- DL mode: students enrolled in an asynchronous teaching mode were significantly less likely to adopt LS compared to those benefiting from a mixed mode (synchronous and asynchronous) (OR=0.621; 95% CI:[0.426–0.906]; $p=0.013$). This result highlights the importance of combining synchronous and asynchronous approaches to maximize pedagogical effectiveness.
- Satisfaction with DL: students satisfied with DL were 1.4 times more likely to adopt effective LS compared to dissatisfied students (OR=1.446; 95% CI:[1.064–1.969]; $p=0.019$), emphasizing the central role of satisfaction in fostering optimal learning behaviors.

Other factors examined, such as proficiency with digital tools, internet access, and knowledge of LS, showed positive trends but did not reach statistical significance. Although the pseudo- R^2 value of 0.28 indicates that the model explains 28% of the variability in LS, these findings suggest that additional contextual factors remain to be explored for a more comprehensive understanding of LS adoption. Table 2 summarizes these predictive factors by presenting their OR, CI, and statistical significance.

Figure 2 provides a visual representation of these findings, depicting the OR and 95% CI for the key predictors in the multivariate model. The plotted points correspond to the estimated OR, while the error bars indicate the CI. CI including the value of 1 indicate non-significance, whereas narrower intervals reinforce the robustness of the association. This visualization aids in comparing the impact of different variables on LS adoption. Finally, the overall model fit ($\chi^2=21.58$; $p=0.004$) confirms the relevance of the included variables in explaining the observed variations in LS adoption among students.

Table 2. Predictive factors of LS identified by the GEE model

Explanatory factors	Coefficient β	OR	95% CI	p-value
Mode of DL (asynchronous vs. mixed)	-0.476	0.621	[0.426; 0.906]	0.013*
Satisfaction with DL (Yes)	0.369	1.446	[1.064; 1.969]	0.019*

*Statistical significance at $p < 0.05$

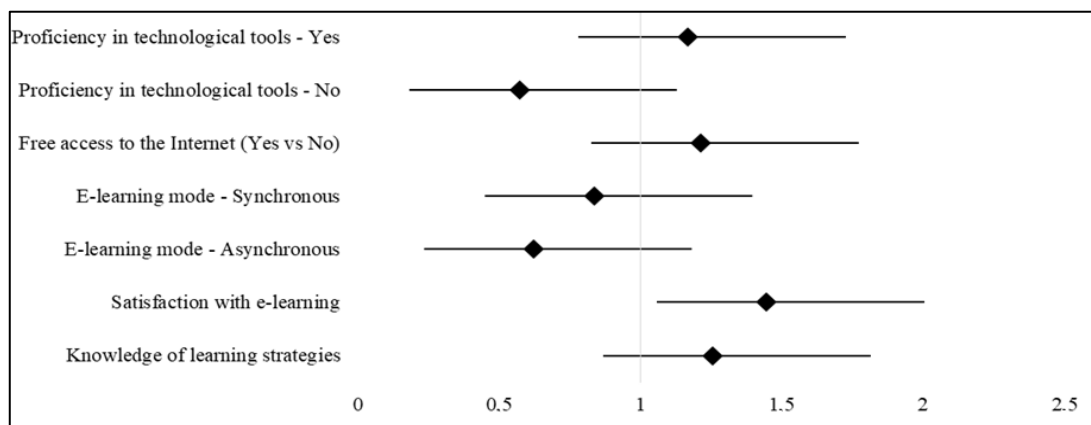


Figure 2. Forest plot of OR for predictive factors of LS (GEE mode)

4. DISCUSSION

This study analyzed the LS adopted by nursing students in the context of DL imposed by the COVID-19 pandemic. The results reveal a high prevalence of metacognitive strategies, such as planning and time management (63.8%), as well as cognitive strategies, including memorization (58.9%) and reformulation (41.6%). These findings confirm that even without explicit knowledge of LS (84.5%), students intuitively develop strategies to manage their learning [25], [27]. These studies highlighted a strong correlation between LS training and academic success. However, our results show that while students spontaneously adopt LS, these strategies may have limitations in terms of efficiency and structure. Thus, although students implement LS, they could benefit from structured instruction.

Therefore, it is essential to integrate explicit LS training into nursing curricula to better support students in DL. The organization of workshops, self-regulation modules, and individualized support could enhance the effectiveness of adopted strategies and improve performance in DL settings. The multivariate analysis highlights two key factors influencing the adoption of LS: the DL mode and student satisfaction, emphasizing the importance of pedagogical conditions in the effectiveness of these strategies. The results indicate that students following a blended learning model (synchronous and asynchronous) are more likely to adopt effective LS (OR=0.621; $p=0.013$). These findings align with several studies [11], [21], who demonstrate that the combination of real-time interactions and autonomous learning enhances engagement. However, the results contrast with those of Pregowska *et al.* [10], who argue that asynchronous learning enhances autonomy and improves individual organization. This discrepancy may stem from the specific demands of health sciences education, which require greater instructional support due to its practical nature. Consequently, a blended online learning model, integrating interactive synchronous sessions and structured asynchronous activities, appears to be the optimal approach. Additionally, training educators in digital tools is crucial to fully leveraging the benefits of blended learning.

Moreover, student satisfaction with DL also plays a crucial role in LS adoption (OR=1.446; $p=0.019$). This finding supports the work of Arco *et al.* [38], who demonstrated that a positive perception of the learning environment is strongly associated with academic engagement. However, our conclusions differ from those of Mishra *et al.* [20], who associate student dissatisfaction primarily with technological and pedagogical constraints. In our sample, these aspects did not reach statistical significance, likely due to the relatively homogeneous access to digital resources. Thus, student satisfaction, which is largely shaped by interaction quality and content structure, may be a key determinant of engagement and academic success in DL settings. It is crucial to foster an interactive learning environment, incorporating discussion forums and collaborative platforms. Furthermore, individualized feedback sessions, as well as initiatives aimed at strengthening students' sense of belonging to a learning community (e.g., group activities, mentoring, virtual clinical supervision), could enhance satisfaction and student performance.

Regarding digital competencies, our study reveals that they did not have a direct impact on the overall adoption of LS. However, they significantly influenced sense-making and information retrieval strategies ($p=0.017$), highlighting their importance in autonomous learning management. This finding aligns with Duarte and Rodríguez [39], who emphasized the role of digital skills in optimizing online learning environments. However, it contrasts with the conclusions of Torun [40], who identified e-learning readiness—including digital tool training—as a strong predictor of academic success in DL. This discrepancy is likely due to the specificities of nursing education, where the acquisition of theoretical and practical knowledge often takes precedence over digital tool proficiency. Nonetheless, our results underscore the importance of integrating digital literacy training into curricula, particularly to facilitate platform navigation, the use of simulation technologies, and the management of digital resources.

The analysis of institutional initiatives reveals that planning and time management were facilitated by the early distribution of course materials (79%) and the regular publication of schedules (77%). These findings are consistent with López *et al.* [41], who suggest that structured access to pedagogical resources enhances student self-regulation. The integration of advanced technologies, such as adaptive learning platforms and intelligent time management tools, could further enhance these initiatives [42]. However, the abrupt transition to DL exacerbated self-regulation difficulties among some students, leading to increased stress and anxiety [9], [43]–[45]. These results highlight the necessity of personalized support, including mentorship and psychological assistance, to mitigate these negative effects.

Another key aspect concerns academic engagement, which is significantly associated with the DL mode ($p=0.045$). Synchronous sessions, mentioned by 43% of students, appear to have fostered higher-quality pedagogical interactions. This finding aligns with previous studies [46], [47], which argue that well-structured synchronous courses enhance engagement and learning outcomes. However, this differs from Razkane *et al.* [48], who emphasize the need to complement synchronous interactions with active learning activities. These results confirm that a balance between synchronous and asynchronous formats is essential to maximize engagement and academic performance.

Finally, student dissatisfaction with DL (69.5%), particularly in nursing education, illustrates the limitations of fully remote learning. This observation is shared by 58.9% of educators, who believe that DL does not adequately meet the requirements of face-to-face learning [18]. These findings contrast with several studies [49], [50], which emphasize the advantages of DL for theoretical instruction. This divergence underscores the specific challenges of health sciences education, where experiential learning is crucial. The integration of advanced educational technologies, including digital simulation, augmented reality, and remote clinical supervision, represents a promising solution. Investing in high-fidelity simulation tools and establishing partnerships with healthcare institutions for remote clinical training could significantly enhance DL in nursing education.

5. CONCLUSION

This study highlights the importance of equipping both students and educators with essential skills for effective digital and blended learning. While nursing students intuitively adopt metacognitive and cognitive strategies, the lack of explicit knowledge about LS underscores the need for targeted pedagogical interventions. The findings reveal that blended learning, which enhances interaction, structure, and student satisfaction, is a key driver of LS adoption. In contrast, digital literacy and internet access alone were not significant predictors, suggesting that infrastructure must be complemented by instructional support to optimize the learning experience. Given the unique challenges of nursing education, particularly its reliance on both practical and clinical training, it is imperative to develop pedagogical frameworks tailored to hands-on learning environments.

These results have critical implications for educational policymakers and institutions seeking to enhance DL in health sciences education. Strengthening DL requires structured LS training, the integration of adaptive learning technologies such as AI-based platforms and virtual simulations, and the promotion of blended learning models that balance synchronous and asynchronous approaches. Additionally, ongoing pedagogical and psychological support is essential to foster self-regulation and engagement in students. Future research should explore additional factors influencing LS adoption, such as intrinsic motivation and social support, while also evaluating the long-term effects of these strategies through longitudinal studies. By fostering more flexible and resilient learning models, institutions can ensure inclusive and high-quality education, even in times of crisis.

Despite the richness of the collected data, this study has certain limitations that may affect its conclusions. The use of convenience sampling limits the generalizability of the results to all nursing students in Morocco. Additionally, reliance on self-reported responses introduces the potential for reporting bias, as some participants may overestimate or underestimate their learning practices. Lastly, the cross-sectional nature of the study does not allow for the establishment of causal relationships between the explored variables. These limitations highlight the need for further research, particularly longitudinal studies, to deepen the understanding of LS in diverse contexts.

FUNDING INFORMATION

The authors declare that no funding was received for the conduct of this research.

AUTHOR CONTRIBUTIONS STATEMENT

The contributions of each author are detailed according to the CRediT taxonomy, as required by the journal. All authors have read and agreed to the published version of the manuscript.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Khadija Ait Moussa	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Sabah Selmaoui		✓		✓			✓			✓		✓	✓	
Nadia Ouzennou	✓	✓		✓			✓			✓		✓	✓	

C : Conceptualization	I : Investigation	Vi : Visualization
M : Methodology	R : Resources	Su : Supervision
So : Software	D : Data Curation	P : Project administration
Va : Validation	O : Writing - Original Draft	Fu : Funding acquisition
Fo : Formal analysis	E : Writing - Review & Editing	

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

ETHICAL APPROVAL

The research involving human participants complied with all relevant national regulations and institutional policies, in accordance with the tenets of the Helsinki Declaration. Ethical approval was granted by the administration of the ISPITS-M. An informed consent statement was embedded at the beginning of the questionnaire, explicitly outlining the study's purpose, the voluntary nature of participation, the right to withdraw at any time, and the strict confidentiality of all collected data. Participants' anonymity and the protection of personal information were rigorously upheld throughout the entire research process.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author [KAM], upon reasonable request.

REFERENCES

- [1] O. B. Adedoyin and E. Soykan, "COVID-19 pandemic and online learning: the challenges and opportunities," *Interactive Learning Environments*, vol. 31, no. 2, pp. 863–875, Feb. 2023, doi: 10.1080/10494820.2020.1813180.
- [2] I. B. Barreto, R. M. S. Sanchez, W. S. Sanchez, O. H. Jordan, and J. D. B. Escalante, "The process of digital transformation in education during the COVID-19 pandemic," *International Journal of Professional Business Review*, vol. 8, no. 9, p. e03770, Sep. 2023, doi: 10.26668/businessreview/2023.v8i9.3770.
- [3] A. Bozkurt and R. C. Sharma, "Emergency remote teaching in a time of global crisis due to coronavirus pandemic," *Asian Journal of Distance Education*, vol. 15, no. 1, pp. 1–6, 2020.
- [4] S. Dhawan, "Online learning: a panacea in the time of COVID-19 crisis," *Journal of Educational Technology Systems*, vol. 49, no. 1, pp. 5–22, Sep. 2020, doi: 10.1177/0047239520934018.
- [5] J. König, D. J. Jäger-Biela, and N. Glutsch, "Adapting to online teaching during COVID-19 school closure: teacher education and teacher competence effects among early career teachers in Germany," *European Journal of Teacher Education*, vol. 43, no. 4, pp. 608–622, Aug. 2020, doi: 10.1080/02619768.2020.1809650.
- [6] T. Trust and J. Whalen, "Should teachers be trained in emergency remote teaching? Lessons learned from the COVID-19 pandemic," *Journal of Technology and Teacher Education*, vol. 28, no. 2, pp. 189–199, 2020.
- [7] W. Bao, "COVID-19 and online teaching in higher education: a case study of Peking University," *Human Behavior and Emerging Technologies*, vol. 2, no. 2, pp. 113–115, Apr. 2020, doi: 10.1002/hbe2.191.
- [8] F. Martin and D. U. Bolliger, "Engagement matters: student perceptions on the importance of engagement strategies in the online learning environment," *Online Learning Journal*, vol. 22, no. 1, pp. 205–222, 2018, doi: 10.24059/olj.v22i1.1092.
- [9] G. Oliveira, J. G. Teixeira, A. Torres, and C. Morais, "An exploratory study on the emergency remote education experience of higher education students and teachers during the COVID-19 pandemic," *British Journal of Educational Technology*, vol. 52, no. 4, pp. 1357–1376, Jul. 2021, doi: 10.1111/bjet.13112.
- [10] A. Pregowska, K. Masztalerz, M. Garlińska, and M. Osial, "A worldwide journey through distance education—from the post office to virtual, augmented and mixed realities, and education during the COVID-19 pandemic," *Education Sciences*, vol. 11, no. 3, p. 118, Mar. 2021, doi: 10.3390/educsci11030118.
- [11] C. Rapanta, L. Botturi, P. Goodyear, L. Guàrdia, and M. Koole, "Online university teaching during and after the COVID-19 crisis: refocusing teacher presence and learning activity," *Postdigital Science and Education*, vol. 2, no. 3, pp. 923–945, Oct. 2020, doi: 10.1007/s42438-020-00155-y.
- [12] J. Crawford *et al.*, "COVID-19: 20 countries' higher education intra-period digital pedagogy responses," *Journal of Applied Learning and Teaching*, vol. 3, no. 1, pp. 9–28, Apr. 2020, doi: 10.37074/jalt.2020.3.1.7.
- [13] H. El Omari *et al.*, "E-learning experience during COVID-19 pandemic management: perception of secondary schools teachers' in Morocco," *Scientific African*, vol. 19, p. e01536, Mar. 2023, doi: 10.1016/j.sciaf.2022.e01536.
- [14] T. Gonzalez *et al.*, "Influence of COVID-19 confinement on students' performance in higher education," *PLoS ONE*, vol. 15, no. 10, p. e0239490, Oct. 2020, doi: 10.1371/journal.pone.0239490.
- [15] E. M. Onyema *et al.*, "Impact of Coronavirus pandemic on education," *Journal of Education and Practice*, vol. 11, no. 13, pp. 108–121, May 2020, doi: 10.7176/JEP/11-13-12.
- [16] S. El Firdoussi, M. Lachgar, H. Kabaili, A. Rochdi, D. Goujdami, and L. El Firdoussi, "Assessing distance learning in higher education during the COVID-19 pandemic," *Education Research International*, vol. 2020, pp. 1–13, Dec. 2020, doi: 10.1155/2020/8890633.
- [17] G. Korkmaz and Ç. Toraman, "Are we ready for the post-COVID-19 educational practice? an investigation into what educators think as to online learning," *International Journal of Technology in Education and Science*, vol. 4, no. 4, pp. 293–309, Sep. 2020, doi: 10.46328/ijtes.v4i4.110.
- [18] B. Mounjid, E. El Hilali, F. Amrani, and M. Moubtassime, "Teachers' perceptions and the challenges of online teaching/learning in morocco during COVID-19 crisis," *Arab World English Journal*, vol. 7, no. 1, pp. 38–52, Jul. 2021, doi: 10.24093/awej/call7.3.
- [19] R. Khalil *et al.*, "The sudden transition to synchronized online learning during the COVID-19 pandemic in Saudi Arabia: a qualitative study exploring medical students' perspectives," *BMC Medical Education*, vol. 20, no. 1, p. 285, Dec. 2020, doi: 10.1186/s12909-020-02208-z.
- [20] L. Mishra, T. Gupta, and A. Shree, "Online teaching-learning in higher education during lockdown period of COVID-19 pandemic," *International Journal of Educational Research Open*, vol. 1, p. 100012, 2020, doi: 10.1016/j.ijedro.2020.100012.
- [21] S. Z. M. Osman, "Combining Synchronous and Asynchronous Learning: Student Satisfaction with Online Learning using Learning Management Systems," *Journal of Education and e-Learning Research*, vol. 9, no. 3, pp. 147–154, Aug. 2022, doi: 10.20448/jeelr.v9i3.4103.

- [22] M. Al-Balas *et al.*, "Distance learning in clinical medical education amid COVID-19 pandemic in Jordan: current situation, challenges, and perspectives," *BMC Medical Education*, vol. 20, no. 1, p. 341, Dec. 2020, doi: 10.1186/s12909-020-02257-4.
- [23] N. Johnson, G. Veletsianos, and J. Seaman, "U.S. faculty and administrators' experiences and approaches in the early weeks of the COVID-19 pandemic," *Online Learning Journal*, vol. 24, no. 2, pp. 6–21, Jun. 2020, doi: 10.24059/olj.v24i2.2285.
- [24] R. E. Mayer, "Learning strategies: An overview," in *Learning and Study Strategies: Issues in Assessment, Instruction, and Evaluation*, C. E. Weinstein, E. T. Goetz, and P. A. Alexander, Eds., San Diego, CA: Academic Press, Inc., 1988, pp. 11–22, doi: 10.1016/B978-0-12-742460-6.50008-6.
- [25] J. Broadbent, "Comparing online and blended learner's self-regulated learning strategies and academic performance," *Internet and Higher Education*, vol. 33, pp. 24–32, Apr. 2017, doi: 10.1016/j.iheduc.2017.01.004.
- [26] J. Dunlosky, K. A. Rawson, E. J. Marsh, M. J. Nathan, and D. T. Willingham, "Improving Students' Learning with Effective Learning Techniques," *Psychological Science in the Public Interest*, vol. 14, no. 1, pp. 4–58, Jan. 2013, doi: 10.1177/1529100612453266.
- [27] B. J. Zimmerman, "Becoming a self-regulated learner: an overview," *Theory into Practice*, vol. 41, no. 2, pp. 64–70, May 2002, doi: 10.1207/s15430421tip4102_2.
- [28] N. Bergdahl and J. Nouri, "Student engagement and disengagement in TEL – the role of gaming, gender and non-native students," *Research in Learning Technology*, vol. 28, pp. 1–16, Aug. 2020, doi: 10.25304/rlt.v28.2293.
- [29] K. Mukhtar, K. Javed, M. Arooj, and A. Sethi, "Advantages, limitations and recommendations for online learning during COVID-19 pandemic era," *Pakistan Journal of Medical Sciences*, vol. 36, no. COVID19-S4, pp. S27–S31, May 2020, doi: 10.12669/pjms.36.COVID19-S4.2785.
- [30] R. A. Rasheed, A. Kamsin, and N. A. Abdullah, "Challenges in the online component of blended learning: a systematic review," *Computers and Education*, vol. 144, p. 103701, Jan. 2020, doi: 10.1016/j.compedu.2019.103701.
- [31] J. L. Moore, C. Dickson-Deane, and K. Galyen, "E-learning, online learning, and distance learning environments: are they the same?" *The Internet and Higher Education*, vol. 14, no. 2, pp. 129–135, Mar. 2011, doi: 10.1016/j.iheduc.2010.10.001.
- [32] J.-L. Wolfs, *Working methods and learning strategies*. Bruxelles: De Boeck Supérieur (in French), 2007, doi: 10.3917/dbu.wolfs.2007.01.
- [33] A. Agresti, *Categorical data analysis (Wiley series in probability and statistics)*, 2nd ed. Hoboken, NJ: John Wiley & Sons, Inc., 2002, doi: 10.1002/0471249688.
- [34] S. Tufféry, *Data mining and decision-making statistics*, 4th ed. Paris: Technip Editions, 2012.
- [35] M. A. Islam and R. I. Chowdhury, "Generalized estimating equation," in *Analysis of Repeated Measures Data*, M. A. Islam and R. I. Chowdhury, Eds., Singapore: Springer Singapore, 2017, pp. 161–167, doi: 10.1007/978-981-10-3794-8_12.
- [36] J. W. Hardin and J. M. Hilbe, *Generalized estimating equations*, 1st ed. New York: Chapman and Hall/CRC, 2002, doi: 10.1201/9781420035285.
- [37] D. W. Hosmer, S. Lemeshow, and R. X. Sturdivant, *Applied logistic regression*. Hoboken: John Wiley & Sons, 2013, doi: 10.1002/9781118548387.
- [38] I. D. Arco, Ö. Flores, and A. Ramos-Pla, "Structural model to determine the factors that affect the quality of emergency teaching, according to the perception of the student of the first university courses," *Sustainability*, vol. 13, no. 5, p. 2945, Mar. 2021, doi: 10.3390/su13052945.
- [39] R. E. Duarte and L. Rodríguez, "Self-perceived digital competencies in educational online migration due to COVID-19 confinement," *Higher Learning Research Communications*, vol. 11, no. 1, pp. 47–63, Jun. 2021, doi: 10.18870/hlrc.v11i1.1191.
- [40] E. D. Torun, "Online Distance Learning in Higher Education: E-Learning Readiness as a Predictor of Academic Achievement," *Open Praxis*, vol. 12, no. 2, pp. 191–208, Jun. 2019, doi: 10.5944/openpraxis.12.2.1092.
- [41] M. C. López, I. Á. Ruiz, and E. J. L. Simón, "Emotional cognitive regulation in university students during lockdown: a comparative analysis of students from Spanish universities," *Sustainability*, vol. 13, no. 12, p. 6946, Jun. 2021, doi: 10.3390/su13126946.
- [42] D. Ifenthaler and J. Y.-K. Yau, "Utilising learning analytics to support study success in higher education: a systematic review," *Educational Technology Research and Development*, vol. 68, no. 4, pp. 1961–1990, Aug. 2020, doi: 10.1007/s11423-020-09788-z.
- [43] W. Cao *et al.*, "The psychological impact of the COVID-19 epidemic on college students in China," *Psychiatry Research*, vol. 287, p. 112934, May 2020, doi: 10.1016/j.psychres.2020.112934.
- [44] M. D. Slivkoff, C. Johnson, and S. Tackett, "First-year medical student experiences adjusting to the immediate aftermath of COVID-19," *Medical Science Educator*, vol. 31, no. 2, pp. 557–564, Apr. 2021, doi: 10.1007/s40670-021-01213-1.
- [45] E. W. Villanueva, H. Meissner, and R. W. Walters, "Medical student perceptions of the learning environment, quality of life, and the school of medicine's response to the COVID-19 pandemic: a single institution perspective," *Medical Science Educator*, vol. 31, no. 2, pp. 589–598, Apr. 2021, doi: 10.1007/s40670-021-01223-z.
- [46] S. Fabrizi, J. Mendzheritskaya, and S. Stehle, "Impact of Synchronous and Asynchronous Settings of Online Teaching and Learning in Higher Education on Students' Learning Experience During COVID-19," *Frontiers in Psychology*, vol. 12, p. 733554, Oct. 2021, doi: 10.3389/fpsyg.2021.733554.
- [47] A. Ouajdouni, K. Chafik, and O. Boubker, "Evaluation of e-learning system during the COVID-19 pandemic in Morocco: a partial least squares modeling approach," *International Journal of Information and Education Technology*, vol. 12, no. 6, pp. 492–499, 2022, doi: 10.18178/ijiet.2022.12.6.1646.
- [48] H. Razkane, A. Y. Sayeh, and M. Yeou, "University teachers' attitudes towards distance learning during COVID-19 pandemic: hurdles, challenges, and take-away lessons," *European Journal of Interactive Multimedia and Education*, vol. 3, no. 1, p. e02201, Dec. 2021, doi: 10.30935/ejimed/11436.
- [49] K. Rahali *et al.*, "Ibn Tofail's University students' satisfaction evaluation towards distance learning and its impacts on the students' mental health during the COVID 19 confinement," *Bangladesh Journal of Medical Science*, vol. 19, pp. S51–S57, Jul. 2020, doi: 10.3329/bjms.v19i0.48166.
- [50] M. Bączek, M. Zagańczyk-Bączek, M. Szpringer, A. Jaroszyński, and B. Woźakowska-Kapłon, "Students' perception of online learning during the COVID-19 pandemic: a survey study of polish medical students," *Medicine*, vol. 100, no. 7, p. E24821, Feb. 2021, doi: 10.1097/MD.00000000000024821.

BIOGRAPHIES OF AUTHORS

Khadija Ait Moussa    is a nursing science instructor at the Higher Institute of Nursing and Health Techniques of Marrakech (ISPITS), Morocco. She is also a Ph.D. candidate at the Interdisciplinary Research Laboratory in Didactics, Education, and Training (LIRDEF) at the École Normale Supérieure (ENS), Cadi Ayyad University, Marrakech. Her passion lies in improving the quality of teaching and learning in health sciences. She can be contacted at email: aitmoussakhadija33@gmail.com, khadija.aitmoussa@ced.uca.ma.



Sabah Selmaoui    is associate professor of the Center for Research and Development in Education (CRDE), Moncton University, Canada. She is research professor in Didactics of Sciences (life and earth sciences) at Ecole Normale Supérieure (ENS), Cadi Ayyad University, Marrakech since 1994. She is interested at the description and understanding problems in the teaching-learning of life and earth sciences. The research conducted focused on a variety of actors in the education system (curricula, learners, and teachers). The research has been the subject of several publications (books and chapters, indexed journals, conferences). She can be contacted at email: sselmaoui@gmail.com.



Nadia Ouzennou    is a professor and researcher in health and biology at the Higher Institute of Nursing and Health Techniques of Marrakech (ISPITS), Morocco. She is involved in a number of research projects in the field of health and nursing. Her research focuses mainly on maternal and child health, oncology, and non-communicable diseases. She is the author of several peer-reviewed international publications. She can be contacted at email: nadia.ouzenou@gmail.com.